

**CLAIMS**

1. A delivery device for delivering a metered amount of substance on each actuation thereof, comprising:  
a delivery unit (7) operable to deliver a metered amount of substance, the delivery unit (7) including a piston member (43) which, in a reciprocating movement, primes, meters and delivers a metered amount of substance; and  
an actuation mechanism (9) actuatable by a user to operate the delivery unit (7), the actuation mechanism (9) comprising an actuator member (53) to which a user applies an actuation force (F) in substantially a single direction, and being configured to effect the reciprocating movement of the piston member (43) on application of the actuation force (F).
2. The device of claim 1, wherein the delivery unit (7) comprises a metering cavity (35) in fluid communication with a reservoir (23) for storing substance, and the piston member (43) is reciprocatingly movably disposed in the metering cavity (35) along a piston axis, the piston member (43) being movable in a first direction to a first, primed position to draw substance into the metering cavity (35) and thereby prime the delivery unit (7), and a second direction, opposite to the first direction, to a second, delivered position to meter and deliver a metered amount of substance from the metering cavity (35).
3. The device of claim 2, wherein the actuation mechanism (9) further comprises a gear assembly (57) which is operably coupled to the piston member (43) and the actuator member (53) such as to effect the reciprocating movement of the piston member (43) on application of the actuation force (F) to the actuator member (53).
4. The device of claim 3, wherein the gear assembly (57) comprises a first, drive gear (71) which is rotatable about a pivot (73) and driven

by actuation of the actuator member (53), and a second, driven gear (74) which is rotatable about a pivot (75), driven by the drive gear (71) and operably coupled to the piston member (43).

5. The device of claim 4, wherein the actuation mechanism (9) further comprises a drive member (55) which operably couples the piston member (43) and the driven gear (74).
6. The device of claim 5, wherein the drive member (55) is pivotally mounted about a pivot (81) such as to be reciprocatingly pivoted by the driven gear (74).
7. The device of claim 6, wherein the drive member (55) is configured such that the piston member (43) is moved at a greater speed in the second direction during a delivery stroke in which substance is delivered from the metering cavity (35) than in the first direction during a priming stroke over a length equal to the delivery stroke in which substance is drawn into the metering cavity (35).
8. The device of claim 7, wherein the pivot (81) of the drive member (55) is located in a position offset from an axis extending through the pivot (75) of the driven gear (74) and orthogonal to the piston axis.
9. The device of any of claims 6 to 8, wherein the driven gear (74) includes a drive pin (79) on a face thereof which engages the drive member (55).
10. The device of any of claims 3 to 9, wherein the drive gear (71) includes  $n$  lugs (76a, 76b, 76c) on a face thereof, the lugs (76a, 76b, 76c) being equi-angularly spaced and having an angular spacing ( $\alpha$ ) of  $360/n$  degrees, and the actuator member (53) is configured to rotate the drive gear (71) through  $360/n$  degrees on each actuation thereof.

11. The device of claim 10, wherein the driven gear (74) has a diameter of  $1/n$  of that of the drive gear (71) such that, for each actuation of the actuator member (53), the driven gear (74) is rotated through 360 degrees.
12. The device of any of claims 2 to 11, wherein the metering cavity (35) includes a peripheral wall (36) and the piston member (43) includes a piston (45) which is a sealing fit with the peripheral wall (36) of the metering cavity (35), the piston (45) having a pressure face for acting on the substance.
13. The device of claim 12, wherein the peripheral wall (36) of the metering cavity (35) includes a transfer port (39), the transfer port (39) being located at a position between the positions of the pressure face of the piston (45) when the piston member (43) is in the primed and delivered positions, and providing for the transfer of substance from the metering cavity (35) to the reservoir (23) with movement of the piston member (43) in the second direction until closed by the piston (45).
14. The device of claim 13, wherein, prior to actuation of the actuator member (53), the piston member (43) is located such as to close the transfer port (39).
15. The device of claim 14, wherein, prior to actuation of the actuator member (53), the piston member (43) is located such as to close the metering cavity (35) from an external environment.
16. The device of any of claims 1 to 15, further comprising:  
a storage unit (3) including a reservoir (23) for storing substance in fluid communication with the delivery unit (7).

17. The device of any of claims 1 to 16, further comprising:  
an outlet unit (5) in fluid communication with the delivery unit (7) from which substance is delivered.
18. The device of claim 17, wherein the outlet unit (5) comprises a spray nozzle.
19. A delivery device for delivering a metered amount of substance on each actuation thereof, comprising:  
a delivery unit (7) operable to deliver a metered amount of substance, wherein the delivery unit (7) comprises a metering cavity (35) in fluid communication with a reservoir (23) for storing substance, and a piston member (43) reciprocatingly movably disposed in the metering cavity (35) along a piston axis, the piston member (43) being movable in a first direction to a first, primed position to draw substance into the metering cavity (35) and thereby prime the delivery unit (7), and a second direction, opposite to the first direction, to a second, delivered position to meter and deliver a metered amount of substance from the metering cavity (35); and  
an actuation mechanism (9) actuatable by a user to operate the delivery unit (7), the actuation mechanism (9) comprising an actuator member (53) to which a user applies an actuation force (F), and being configured to effect the reciprocating movement of the piston member (43) on application of the actuation force (F), with the piston member (43) being moved at a greater speed in the second direction during a delivery stroke in which substance is delivered from the metering cavity (35) than in the first direction during a priming stroke over a length equal to the delivery stroke in which substance is drawn into the metering cavity (35).
20. The device of claim 19, wherein the actuator member (53) is configured such that a user applies the actuation force (F) in substantially a single direction.

21. The device of claim 19 or 20, wherein the actuation mechanism (9) further comprises a gear assembly (57) which is operably coupled to the piston member (43) and the actuator member (53) such as to effect the reciprocating movement of the piston member (43) on application of the actuation force (F) to the actuator member (53).
22. The device of claim 21, wherein the gear assembly (57) comprises a first, drive gear (71) which is rotatable about a pivot (73) and driven by actuation of the actuator member (53), and a second, driven gear (74) which is rotatable about a pivot (75), driven by the drive gear (71) and operably coupled to the piston member (43).
23. The device of claim 22, wherein the actuation mechanism (9) further comprises a drive member (55) which operably couples the piston member (43) and the driven gear (74).
24. The device of claim 23, wherein the drive member (55) is pivotally mounted about a pivot (81) such as to be reciprocatingly pivoted by the driven gear (74).
25. The device of claim 24, wherein the pivot (81) of the drive member (55) is located in a position offset from an axis extending through the pivot (75) of the driven gear (74) and orthogonal to the piston axis.
26. The device of any of claims 23 to 25, wherein the driven gear (74) includes a drive pin (79) on a face thereof which engages the drive member (55).
27. The device of any of claims 22 to 26, wherein the drive gear (71) includes  $n$  lugs (76a, 76b, 76c) on a face thereof, the lugs (76a, 76b, 76c) being equi-angularly spaced and having an angular spacing ( $\alpha$ ) of  $360/n$  degrees, and the actuator member (53) is configured to

rotate the drive gear (71) through  $360/n$  degrees on each actuation thereof.

28. The device of claim 27, wherein the driven gear (74) has a diameter of  $1/n$  of that of the drive gear (71) such that, for each actuation of the actuator member (53), the driven gear (74) is rotated through 360 degrees.
29. The device of any of claims 19 to 28, wherein the metering cavity (35) includes a peripheral wall (36) and the piston member (43) includes a piston (45) which is a sealing fit with the peripheral wall (36) of the metering cavity (35), the piston (45) having a pressure face for acting on the substance.
30. The device of claim 29, wherein the peripheral wall (36) of the metering cavity (35) includes a transfer port (39), the transfer port (39) being located at a position between the positions of the pressure face of the piston (45) when the piston member (43) is in the primed and delivered positions, and providing for the transfer of substance from the metering cavity (35) to the reservoir (23) with movement of the piston member (43) in the second direction until closed by the piston (45).
31. The device of claim 30, wherein, prior to actuation of the actuator member (53), the piston member (43) is located such as to close the transfer port (39).
32. The device of claim 31, wherein, prior to actuation of the actuator member (53), the piston member (43) is located such as to close the metering cavity (35) from an external environment.
33. The device of any of claims 19 to 32, further comprising:

a storage unit (3) including a reservoir (23) for storing substance in fluid communication with the delivery unit (7).

34. The device of any of claims 19 to 33, further comprising:  
an outlet unit (5) in fluid communication with the delivery unit (7)  
from which substance is delivered.
35. The device of claim 34, wherein the outlet unit (5) comprises a spray nozzle.
36. A delivery device for delivering a metered amount of substance on each actuation thereof substantially as hereinbefore described with reference to the accompanying drawings.